Shannon ABC
Applied Biotechnology Centre

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BIOTECH FOR BUSINESS

MICROALGAL BIOTECHNOLOGY AT SHANNON ABC

Microalgae are microscopic organisms that grow using sunlight. They are considered as a very promising feedstock for sustainable supply of commodities for both food and non-food products. They have the most recognition for potential production of biofuels, but they are also a promising source for proteins, lipids and carbohydrates for the food/feed industries, and other high-value molecules for cosmetics and pharmaceutical applications.

Microalgal Biotechnologist Dr. Sushanta Kumar Saha and his research team have been researching microalgae at Shannon ABC for nearly a decade. They have established a **biobank of Irish marine cyanobacteria and microalgae**, which is an on-going project with about 100 pure strains at present. These microalgal and cyanobacterial strains are used for a variety of biotechnological explorations.

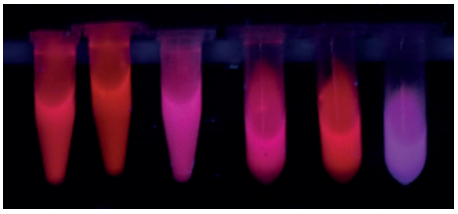
Dr. Sushanta Kumar Saha working with microalgae at Shannon ABC.

Recent projects include:

N-COLOURANT (**Natural food COLOURANT** with nutritional benefits from Irish marine cyanobacteria and microalgae) this project was funded from the Enterprise Ireland Commercialisation Fund Programme to develop technologies for natural food colourant from microalgae and cyanobacteria, and was delivered in collaboration with Teagasc.

Pilot Scale biomass production and formulations of Cosmetics products with microalgal bioactive ingredients.

This project was funded through Enterprise Ireland's Innovation Partnership Programme and is a collaboration with TanOrganic with work packages being delivered in both sites of Shannon ABC – in LIT and MTU.



Development of commercialisation pipeline of Microalgal bioFACTORIES starting from biodiscovery screening (M-FACTORIES). This project was funded through Bord Iascaigh Mhara's (BIM) Knowledge Gateway Scheme and is a collaboration between LIT, MTU and Teagasc.

This collaborative project will employ three researchers across the Institutes over the two years period to develop an innovative microalgal commercialisation pipeline for proteins and lipids.

Recent publications:

Shiels, K., Murray, P. and Saha, S.K. 2019. Marine cyanobacteria as potential alternative source for GABA production. Bioresource Technology Reports, 8, 100342. https://doi.org/10.1016/j.biteb.2019.100342

Shiels, K., Browne, N., Donovan, F., Murray, P. and Saha, S.K. 2019. Molecular Characterization of Twenty-Five Marine Cyanobacteria Isolated from Coastal Regions of Ireland. Biology, 8, 59. https://doi.org/10.3390/biology8030059

In excess of €800,000 for new Equipment for Shannon ABC

Shannon ABC was awarded in excess of €800,000 in June 2020 to purchase new equipment to help support Irish companies across the Life Sciences, Food & Drink, Cosmetic, Marine, Biotechnology, Environmental and Healthcare sectors. Six successful applicants from Shannon ABC secured equipment that will assist in its expansion of R&D support for this range of sectors.

In the last two years, Shannon ABC has successfully secured nearly €2 million to purchase new equipment, which is transforming the support which the Centre provides Irish industries.

The most recent award purchased equipment includes:

- Liquid Chromatographer Tandem Quadrupole Mass Spectrometer
- Gas Chromatography Infrared Interface
- Microalgae Cultivation Suite
- Plate Reader
- Cosmetic Testing Suite
- High Throughput Enzyme-linked Immunosorbent Assay (ELISA) suite

This equipment will facilitate and encourage more companies to engage in collaborative R&D with Shannon ABC researchers. It will also provide enhanced technology validation and testing capabilities as well as test bed generation with the added advantage of enhancing the training potential for key industry staff on emerging technologies.

SHANNON ABC

Biowill – Willow Tree Bioferinery

BioWILL is an Interreg NWE funded research project that is a collaboration between 10 partners from Northwest Europe. Coordinated by Professor JJ Leahy at the University of Limerick, the consortium comprises of universities, research institutes, SMEs, consultancy firms, industry forums, a gas company, and an organisation representing farmers and landowners across the EU.

BioWILL is intended to deliver a biorefinery based on the willow tree. Willow is a fast growing crop with low input requirements. It has been explored for its potential use for bioenergy, but never really took off in Ireland. The focus of the BioWILL project is to isolate salicylates from the bark and to then use the bark residue and bark free pulp to manufacture food quality packaging, to replace fossil derived packaging. At the end-of-life of the packaging it can then be used as a feedstock for bio-energy anaerobic digestion.

Shannon ABC's task is based on the salicylate output. Salicylates are a well-known class of compound with a range of health based activities; aspirin is a derivative of salicylic acid. The work in Shannon ABC will focus on the bioactivity of the extracted salicylate and examine anti-inflammatory and anti-oxidant activity in our cell culture models. Dr Niall Burke is leading this work in Shannon ABC and the team will consist of a Research Assistant to deliver the core data, and a PhD student to explore potential skin therapies using the other bioactives present in the willow bark.

Shannon ABC will work with task partners Helicon and Epitheal to develop a medical device cream based on the salicylate and data produced by the Shannon ABC team.

Dissemination of the role of the bioeconomy in everyday life is an essential part of BioWILL and a documentary will be produced during the course of this project, as well as a demonstration lab being on site in Shannon ABC for a 6 month period.

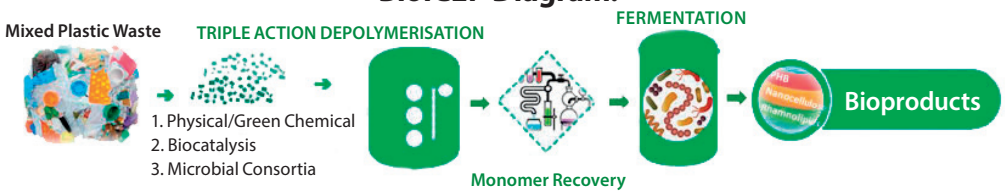
Horizon 2020 "BioICEP" project which tackles plastic waste underway at Shannon ABC

Bio Innovation of a Circular Economy for Plastics (BioICEP) is a pan European-Chinese collaboration, consisting of 12 European and 3 Chinese partners, to tackle the burden of plastic waste in the environment. The grant worth €5 Million was awarded under the call H2020 topic CE-BIOTEC-05-2919 "Microorganism communities for plastics biodegradation" Research Innovation Action and started in January 2020 running for 4 years in total. The project is co-ordinated by Dr Margaret Brennan Fournet of Athlone Institute of Technology (AIT) and LIT, as one of the BioICEP partners, is represented by Dr Paudie Murray, Dr Catherine Collins and Dr Sushanta Saha of Shannon ABC.

Global production and consumption of plastic has grown exponentially in recent decades. Since the 1950s, approximately 8.3 billion tonnes of plastic have been produced – 60% of which has ended up in landfill or the natural environment. Using an innovative triple action process, the BioICEP team will attempt to accelerate the degradation of traditional plastic and turn it into biopolymers, which can be used as natural biodegradable replacement plastics. The consortium brings together leading experts from industry and academia contributing a set of purpose-designed and ground-breaking technologies in order to achieve the following specific objectives:

1. **Development of accelerated high-efficiency biodegradation incorporating microorganism communities expressing at least three novel and improved enzymatic activities enabling the degradation of mixtures of plastics.**
2. **Sustainable degradation of at least 20% of mixed plastics.**
3. **Bioprocessed high value bioproducts including equivalent bioplastics valorising mixed plastic waste.**
4. **Sustainable prototype system plan, paving the way to bring the developed solution to the market, fulfilling current needs, future expectations, and delivering a seamless bio-innovative route for a circular economy for plastics**

BioICEP Diagram:



Catherine Collins and Mariana Alves are the key researchers working on this project at Shannon ABC and they will apply their biotechnology skills to mimic natural degradation and regeneration by microbes for the systematic bioconversion of plastic wastes into value added bio-plastics. They will screen existing and new fungal and algal biobanks at LIT for plastic degraders and bioplastic producers. Mechano-biochemical disintegration processes of plastic polymers aim to make waste plastics amenable to biodegradation. Also, plastics will be subjected to enzymatic attack to improve biodegradation rates. Another plan of attack to tackle the waste plastic will be to combine various individual biodegrading microorganisms to form consortia to biodegrade mixed plastic waste. The outputs from this degradation process will be used as building blocks for new polymers or other bioproducts to enable a new plastic waste-based circular economy. More details can be found at the project website https://www.bioicep.eu/index.php and you can also sign up on the project website for free to the BioICEP newsletter for the regular updates on the project.

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MEET THE TEAM

Shannon ABC is a collaboration between Limerick Institute of Technology and the Munster Technological University and the Centre brings together a multidisciplinary team of researchers with commercial specialists so as to provide a centre of excellence in applied research, capable of exploiting opportunities in science and technology to the benefit of the Regional and National economy. Each quarter we will introduce you to some of our team.

DR. ABHAY MENON is a postdoctoral researcher at Shannon ABC, MTU, Tralee working on two European funded projects : 'Biorefinery Glas' (an EIP-Agri project) and 'INGREEN' (a BBI-JU Horizon 2020 project). His research in the Biorefinery Glas project focusses on the extraction, characterization and evaluation of prebiotic activity of fructooligosaccharides obtained from grass extracts. The INGREEN project will deliver functional innovative ingredients from paper and agro-food side-streams through sustainable and efficient tailor-made biotechnological processes for food, feed, pharma and cosmetic industries.

Abhay graduated with a degree (BTech, Anna University) in Biotechnology before completing an MSc (Crop Biotechnology) and PhD (Food and Pharmaceutical engineering) at the University of Nottingham. His PhD research focused on the evaluation of various processing methods and the subsequent effects on bioactive compounds in cocoa beans. Upon completion, he took up two postdoctoral research positions in the field of 'agricultural waste valorisation' in Malaysia (University Nottingham, Malaysia) and UK (Brunel University London), respectively. His research interests are in; food waste valorisation, new product development, nutritional profiling, bioactivity screening and characterization of prebiotics.

DR. HANDE ERMIS received her degree in Bioengineering where she studied two years in Istanbul Technical University and two years in Montana State University; and received double diplomas. She holds a Master's degree in Bioengineering, where she worked on algal biogas production. Dr. Ermis completed her PhD in Environmental Engineering where she focused on wastewater treatment with microalgae at lab-scale and pilot-scale systems along with observation of positive effect on algal biomass. Currently, she is working as a Research Scientist at Shannon ABC Applied Biotechnology Centre in Limerick IT in an industrial research project dedicated to develop cosmetic ingredients through fermentation.

PEI SHEE TAN is a postgraduate student in Shannon ABC, MTU. She is working on a project titled "Laser Flame: Laser Scribed Electrodes as Inflammatory Biosensors" for her postgraduate studies in Shannon ABC in collaboration with the Tyndall National Institute, University College Cork, Her supervisors are Dr Joanna Tierney, Dr Niall Burke and Dr Daniela Iacopino. The project aims to develop a prototype biosensor in detecting biomarkers in immune effector cells, which play important roles in immune surveillance and early stages of disease induction. This type of biosensor holds great potential as a powerful diagnostic tool for managing inflammatory disease conditions.

Pei Shee Tan received her BSc. (Hons) in Pharmaceutical Science with Biopharmaceutics from IT, Tralee in 2019 and was presented the Astellas Award for Outstanding Academic Performance. During her studies, she worked on analytical and molecular biology projects.. She also undertook her work placement in Astellas Pharma Co Ltd in their QC chemistry lab where she gained experience with HPLC and performed all laboratory duties in accordance with GMP and Safety procedures.

RUTH SMITH received her BSc (hons) in Herbal Science from Cork Institute of Technology in 2019. During the course of her degree she undertook a three month internship at the Université de Bourgogne (UB), Science de Santé, Dijon, France, where she worked on extracting and purifying saponins from plants. Her final year research project was focused on analysing the antimicrobial activity of European propolis against antimicrobial resistant microbes.

Currently, Ruth is working on the project titled 'Opti-biome: Natural extracts for dermo-cosmetic skin health' as part of her postgraduate study under the supervision of Dr. Joanna Tierney and Dr. Bridget Breen. The aim of the project is to evaluate the role of natural extracts to support the skin's microbiota and enhance skin health."

Industry Partners

TanOrganic™
BNAM
ppr POST PARTUM RELIEF HEALTHCARE
NutraMara
JNFemme
Reagecon

Shannon ABC
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https://twitter.com/Shannon_ABC

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Case Studies

THE COMPANY
CMP (Commercial Mushroom Producers)

FUNDING SOURCE
Contract research

PROJECT TITLE
Valorisation of spent mushroom compost

PROFILE OF COMPANY
CMP (Commercial Mushroom Producers) is one of Europe's leading horticultural producer organisations. Their business is focused on developing a quality, sustainable and competitive industry in Ireland. They were established as a co-operative in 1999 and represent 90% of Irish mushroom production and growers. CMP represent over 40 mushroom growers and have a combined annual turnover of around €200million, its members employ circa 3,000 people.

PROBLEM TO BE SOLVED
Productivity levels of compost for mushrooms has a fundamental impact on the revenue potential for this sector. Recent events at a global level (Brexit) were devastating for the sector and even just the risk of Brexit resulted in a number of mushroom producers going out of business. All elements that may therefore result in greater productivity for minimal input will greatly support this sector. The project with Shannon ABC was built around this support. We screened mushroom compost at varying stages of use, producing a biological and chemical fingerprint of the compost, linked to productivity levels.

HOW GATEWAY DELIVERED SOLUTION FOR INDUSTRY:
Shannon ABC provided a range of testing to quantify the composition of the compost for the company. These included biochemical, microbiological and analytical results. The combination of this information provided a blueprint for the company as to the characteristics of their compost prior, during and post growth. This has the potential for the CMP to determine productivity levels of the compost prior to mushroom growth, based solely on the compositional analysis. A key component of this work was Infra Red (IR) analysis, which was carried out in collaboration with CAPPA, the Photonics based Technology Gateway in Cork Institute of Technology. IR spectroscopy can be very sensitive to determination of functional groups within a sample since different functional groups absorbs different frequencies of IR radiation. Each molecule has a characteristic spectrum often referred to as its fingerprint. A molecule can also be identified by comparing its absorption peak to a data bank of spectra.

IMPACT FOR THE COMPANY
The data produced by Shannon ABC and CAPPA has provided CMP with information that they did not have previously. It allowed them to determine the qualitative difference between poor, medium and good mushroom yielding compost. Going forward it will enable CMP to ensure their compost is of a certain standard, guaranteeing a good crop of mushrooms.

COMPANY TESTIMONIAL:
"The results from a scientific report we commissioned from Shannon ABC greatly de-risked an investment by giving us a robust understanding of the technical capabilities of a particular type of scientific equipment. This understanding was used to fine tune a tender for the equipment that was performed early in the procurement process, meaning that we were best informed early on and thus got the machine most suited to our needs. We found Shannon ABC open, flexible and understanding of our requirements. CMP looks forward to further successful collaborations with Shannon ABC."
CEO, CMP